## AMENDMENTS TO THE CLAIMS:

Please amend claims 1, 3, 4, 8, 19, 27, 30-39, 42-60, 62-63, 66, 68, 70, and 72-78, as follows.

This listing of claims will replace all prior versions and listings of claims in the Application:

**Claim 1 (currently amended):** A storage device, comprising:

a write head that encodes strands of molecular material with sequences of binary data;

a storage block for storing the strands;

a read head for reading out a sequence of binary data from a selected strand; and

a transport mechanism that selectively moves the strands between the ~~read and~~ write ~~heads~~head and the storage block, or in response to a read command, between the storage dock and the read head, and then to a dump or back to the storage block.

**Claim 2 (original):** The storage device of claim 1, wherein the strand includes a number of molecular bases that are encoded with the binary data, said read head detecting each base or collection of the bases within the strand to read out the binary data directly from the strand.

**Claim 3 (currently amended):** The storage device of claim 2, wherein the read head comprises:

~~First~~ first and second chambers, which have a shared wall and contain a liquid,

[[A]] a nano-pore in the shared wall;

[[A]] a voltage source that applies a voltage across said first and second chambers thereby producing an ionic current that flows through the nano-pore and pulling strands through the nano-pore as they are presented to the first chamber; and

[[A]] a current meter that measures fluctuations in the ionic current as each base or collection of bases in the strand flows through the nano-pore.

**Claim 4 (currently amended):** The storage device of claim 2, wherein the read head comprises:

[[A]] a chamber that closely confines a strand as it moves therethrough, and

[[A]] a microscopic probe held in close proximity to the passing strand such that the probe interacts with each base or collection of bases and produces a signal indicative of the binary data encoded therein.

**Claim 5 (withdrawn):** The storage device of claim 4, wherein the microscopic probe comprises a scanning tunneling microscope tip that produces a tunneling current between each base or collection of bases and the tip.

**Claim 6 (original):** The storage device of claim 4, wherein the microscopic probe comprises an atomic force microscope tip that deflects when held in close proximity to a base or collection of bases.

**Claim 7 (original):** The storage device of claim 1, wherein said read and write heads and said storage block are integrated on a substrate, further comprising:

at least one reservoir of molecular material located off-substrate that feeds molecular material to the write head; and

a dump located off-substrate for receiving the disposed strand.

**Claim 8 (currently amended):** The storage device of claim 1, wherein said read and write heads and said storage block are integrated on a substrate, further comprising:

at least one reservoir of molecular material located on the substrate that feeds material to the write head; and

a recycle unit located on the substrate for receiving the disposed strand, breaking the strand into molecules and returning them to the at least one reservoir.

**Claim 9 (original):** The storage device of claim 1, wherein the storage block comprises:

a plurality of parking lots for storing the strands;

a respective plurality of actuated gates that control the strands entrance to and exit from the respective parking lots and read and write heads, said actuated gates having unique addresses and being controlled by an external signal; and

a race track that is connected to the parking lots via the actuated gates and acts as a highway for transporting the strands.

**Claim 10 (original):** The storage device of claim 1, wherein the write head receives blank strands and modifies the strands to encode the binary data.

**Claim 11 (original):** The storage device of claim 1, wherein the write head receives distinct molecular bases and synthesizes them into strands to encode the binary data.

**Claim 12 (original):** The storage device of claim 1, wherein the write head encodes the binary data into the base-sequence of the strand.

**Claim 13 (original):** The storage device of claim 1, wherein the write head uses the strand as a support structure on which to encode the binary data.

**Claim 14 (previously presented):** The storage device of claim 11, wherein the molecular material includes at least two distinct bases, said write head comprising:

at least two reservoirs containing the different bases and a blocking group;

a main chamber coupled to the reservoirs by respective nano-pores;

an anchor in the main chamber for holding one end of a seed strand;

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5

electrodes for applying a voltage between the main chamber and a selected reservoir to cause a free-floating end of the seed strand to enter the selected reservoir through its nano-pore where a single base and blocking group are added to the free-floating end of the seed strand and then to return to the main chamber; and

a mechanism that removes the blocking group from the seed strand in the main chamber to prepare the strand for entry into the next reservoir.

**Claim 15 (previously presented):** The storage device of claim 11, wherein the molecular material includes at least two distinct bases, said write head comprising:

a tank partitioned into an upper chamber and a lower chamber connected by a nano-pore, said chambers being filled with a buffer solution and said upper chamber containing enzymes for joining base units to a strand;

a chamber having at least two reservoirs containing different bases in a buffer solution, each reservoir having a nano-pore at one end placed in the upper chamber of the tank;

a plurality of electrodes positioned in the upper and lower chambers and the at least two reservoirs to apply a series of electrical pulses that inject bases from their respective reservoirs into the upper chamber where they are sequentially joined to the strand to encode the sequence of binary data and, once encoded, that transfer the strand to the lower chamber.

**Claim 16 (original):** The storage device of claim 15, further comprising:

a monitoring station that senses the injection of a base into the upper chamber and closes the nano-pores so that only one base is joined to the strand at a time and senses the strand as it passes from the upper chamber through the nano-pore to the lower chamber to ensure that the strand represents the sequence of binary data.

**Claim 17 (previously presented):** The storage device of claim 10, wherein the blank strand comprises molecular bases having at least two states, the write head comprising:

an activator that transforms the bases into one of its states; and

a transport mechanism that pulls the strand past the activator to write the sequence of binary data into the strand.

**Claim 18 (original):** The storage device of claim 17, wherein the blank strand comprises inert segments that separate the bases, the write head further comprising:

an exciser that removes the inert segments from the strand after the bases have been activated; and

a splicer that splices the active molecules back together into the strand.

**Claim 19 (currently amended):** The storage device of claim [[10]]3, wherein the write head comprises:

a first chamber having a strand of molecules and nano-particles;

a second chamber having an access window, a chamber wall separating said first and second chambers having an ion-channel formed therein with the [[trans]]strand side of the wall being chemically modified with surface attached photosensitizer groups capable of reducing the nano-particles;

a transport mechanism for pulling the strand and nano-particles through the ion-channel; and

a laser that emits pulses through the access window to excite the photosensitizers and activate reduction of the nano-particles to form nano-clusters bound to the strand at selected locations to encode the sequence of binary data.

**Claim 20 (original):** The storage device of claim 19, wherein the nano-particles are Ag+ ions.

**Claim 21(previously presented):** The storage device of claim 11, wherein the write head writes the binary data sequence into a strand using a ring-opening metathesis polymerization (ROMP) process.

**Claim 22 (original):** The storage device of claim 1, further comprising a plurality of said read and write heads that address the storage block in parallel.

**Claim 23 (original):** The storage device of claim 1, wherein the strands are electrically charged, said transport mechanism comprising a pair of electrodes that establish an electric field gradient that pull the strands around.

**Claim 24 (original):** The storage device of claim 1, wherein the transport mechanism comprises a laser that forms optical tweezers that grab the strand and pull it around.

**Claim 25 (original):** The storage device of claim 1, wherein the strands reside in a liquid, said transport mechanism comprising one or more micro-fluidic pumps that induce a flow current in the liquid that moves the strand.

**Claim 26 (original):** The storage device of claim 1, wherein the molecular material is DNA having bases of adenine (A), thymine (T), cytosine (C) and guanine (G).

**Claim 27 (currently amended):** The storage device of claim [[28]]26, further comprising a zip unit the forms a double-helix of the DNA strand for storage and an unzip unit that extracts the single strand for the read head.

**Claim 28 (withdrawn):** The storage device of claim 1, wherein the molecular material is RNA having bases of adenine (A), uracil (U), cytosine (C) and guanine (G).

**Claim 29 (withdrawn):** A storage device, comprising:

a plurality of parking lots for storing molecular strands;

a respective plurality of actuated gates that control the strands entrance to and exit from the respective parking lots, said actuated gates having unique addresses and being controlled by an external signal;

a race track that is connected to the parking lots via the actuated gates and acts as a highway for transporting molecular strands;

a transport mechanism that moves the molecular strands to and from the parking lots via the racetrack;

a write station that includes at least one inlet for receiving molecular bases, a write head that synthesizes the bases into strands in-situ to encode a particular binary sequence in a base-sequence of the strand, and an outlet connected to the racetrack; and

a read station that includes an inlet for receiving a strand from the racetrack, a read head for detecting bases or collections of bases in the strand to read out the binary sequence directly from the strand, and one or more outlets for disposing of the strand.

**Claim 30 (currently amended):** A storage device, comprising:

a patterned substrate having a network of liquid-filled canals; and

strands of molecular material encoded with a sequence of binary data in the liquid-filled canals and <u>selectively</u> movable therein between different locations on the substrate <u>in response to an external command</u>.

**Claim 31 (currently amended):** The storage device of claim [[32]] <u>30</u>, further comprising:

a plurality of micro-fluidic valves that control access to the stored strands in addressable locations; and

a transport mechanism that moves the strands around in the liquid-filled canals.

**Claim 32 (currently amended):** The storage device of claim [[33]]31, wherein the strands are electrically charged, said transport mechanism comprising electrodes that establish an electric field gradient in the network of liquid-filled canals that pull the strands through the canals.

**Claim 33 (currently amended):** The storage device of claim [[33]]31, wherein the transport mechanism comprises a laser that forms optical tweezers that grab the strands and pull them through the liquid.

**Claim 34 (currently amended):** The storage device of claim [[33]]31, wherein the transport mechanism comprises at least one micro-fluidic pump that induces a current in the liquid-filled canals that moves the strands.

**Claim 35 (currently amended):** The storage device of claim [[32]]30, further comprising a write station having an inlet for receiving molecular bases, a write head that synthesizes the bases into strands so that a particular sequence of binary data is encoded in a base-sequence of the strand, and an outlet that directs the strand into the network of liquid-filled canals.

**Claim 36 (currently amended):** The storage device of claim [[32]]30, further comprising a write station having an inlet for receiving blank strands of molecular material, a write head that modifies the strand to encode a particular sequence of binary data in a base-sequence of the strand, and an outlet that directs the strand into the network of liquid-filled canals.

**Claim 37 (currently amended):** The storage device of claim [[32]]30, wherein the strand comprises a number of bases or collections of bases encoded with the binary data, further comprising a read station that includes an inlet valve for receiving a strand from the liquid-filled canals, a read head for detecting each base or collection of bases to read out the binary sequence directly from the strand, and one or more outlets for disposing of the molecular material.

**Claim 38 (currently amended):** The storage device of claim [[33]]31, wherein the micro-fluidic valves, comprise:

an inlet;

first and second outlets;

a switch block; and

an actuator that moves the switch block back-and-forth to alternately block said first and second outlet.

**Claim 39 (currently amended):** A storage device, comprising:

a patterned substrate having a network of liquid-filled canals that define parking lots and a racetrack;

a write station that synthesizes distinct molecular bases in-situ into strands to encode a sequence of binary data in the base-sequence of the strand;

a read station that detects bases or collections of bases to read out the binary data sequence directly from the strand;

a plurality of micro-fluidic valves that control access to the parking lots and read and write stations in response to an external signal; and .

a transport mechanism that moves the strands between the write station and the parking lots and between the parking lots and the read and write stations station via the network of liquid-filled canals in response to a read command, and then to a dump or back to the parking lots.

**Claim 40 (withdrawn):** A method of fabricating a storage device as claimed in claim 1, comprising:

Patterning a wafer to form ridges and canals that define a plurality of parking lots, a racetrack that interconnects the parking lots and to form chambers that define a read station and a write station;

Processing the wafer using micro-fluidic fabrication technologies to define micro-fluidic valves in the canals that control access to and from the parking lots and the read and write stations;

Filling the canals with liquid;

Fabricating a control wafer to define a plurality of addressing lines;

Mounting the control wafer on the wafer so that the addressing lines control the micro-fluidic valves; and

Storing at least one strand of molecular material encoded with a sequence of binary data in the liquid-filled canal for at least one said parking lot.

**Claim 41 (withdrawn):** A method of storing and retrieving a sequence of binary data using the storage device of claim 1, comprising:

Writing in-situ a strand of molecular bases that represents a sequence of binary data;

Moving the strand to a memory address;

Storing the strand at the memory address;

Moving the strand from the memory address to a read location; and

Reading each base or collection of bases in the strand to determine an information unit of binary data.

**Claim 42 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the step of writing the strand includes receiving a blank strand and modifying the strand to encode the binary data.

**Claim 43 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the step of writing the strand includes receiving distinct molecular bases and synthesizing them into strands to encode the binary data.

**Claim 44 (withdrawn - currently amended):** The method of claim [[43]]41, wherein writing step encodes the binary data into the base-sequence of strand.

**Claim 45 (withdrawn - currently amended):** The storage device of claim [[43]]41, wherein the writing step uses the strand as a support structure on which to encode the binary data.

**Claim 46 (withdrawn - currently amended):** The method of claim [[45]]43, wherein the strand of molecular bases is written by,

anchoring one end of a seed strand,

applying a voltage to cause a free-floating end of the seed strand to enter through a nano-pore to a selected reservoir where a single molecular base and blocking group are added to the free-floating end of the seed strand;

extracting the strand from the reservoir; and

removing the blocking group from the seed strand to prepare the strand for entry into the next reservoir.

**Claim 47 (withdrawn - currently amended):** The method of claim [[45]]43, wherein the strand is written by,

storing different bases in a buffer solution in at least two different reservoirs;

extracting a single base through nano-pores in the reservoirs into a first chamber filled with buffer solution and enzymes;

joining the base to grow a strand;

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13

repeating the extraction and joinder until the strand is encoded with the binary sequence of data; and

transferring the strand to a second chamber where it can be moved to the memory address.

**Claim 48 (withdrawn - currently amended):** The method of claim [[49]]47, further comprising:

sensing the extraction of a base to close the nano-pores so that only one base is joined to the strand at a time; and

sensing the strand as it passes from the first chamber through a nano-pore to the second chamber to ensure that the strand represents the sequence of binary data.

**Claim 49 (withdrawn - currently amended):** The method of claim [[44]]42, wherein the strand is written by,

receiving a blank strand of bases, each base having at least two possible states; and

selectively transforming the state of each base as the strand is pulled past a write head to write the sequence of binary data into the strand.

**Claim 50 (withdrawn - currently amended):** The method of claim [[51]]49, wherein the bases are separated by inert segments in the blank strand, further comprising after all of the bases are transformed,

excising the inert segments from the strand; and

splicing the active molecules back together to reform the strand.

**Claim 51 (withdrawn - currently amended):** The method of claim [[44]]42, wherein the strand of molecules is written by,

chemically modifying the trans side of a chamber wall with surface attached

photosensitizer groups capable of reducing a certain nano-particle;

pulling a strand of molecules and the certain nano-particles through an ion-channel

formed in a chamber wall; and

emitting laser to excite the photosensitizers and activate reduction of the nano-particles

to form nano-clusters bound to the strand at selected locations to encode the sequence of binary

data.

**Claim 52 (withdrawn - currently amended):** The method of claim [[45]]43, wherein the

strand of molecules is written using a ring-opening metathesis polymerization (ROMP) process.

**Claim 53 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the

strand is read by applying a voltage across a membrane having a nano-pore formed therein

thereby creating an ionic current and pulling strands through the nano-pore thereby creating

fluctuations in the ionic current.

**Claim 54 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the

strand is read by passing it by a microscopic probe that detects the base or collection of bases.

**Claim 55 (withdrawn - currently amended):** The method of claim [[43]]41, wherein after

the strand is read the strand is destroyed.

**Claim 56 (withdrawn - currently amended):** The method of claim [[43]]41, wherein after

the strand is read the strand is broken into its constituent molecules and recycled.

**Claim 57 (withdrawn - currently amended):** The method of claim [[43]]41, wherein after

the strand is read it is returned to the memory address.

**Claim 58 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the

strands are moved by,

electrically charging the strands; and

establishing an electric field gradient in the liquid-filled canals that pulls the strands

around.

**Claim 59 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the

strands are moved by forming optical tweezers that grab the strands and pull them around.

**Claim 60 (withdrawn - currently amended):** The method of claim [[43]]41, wherein the

strands are moved by pumping and thereby inducing a flow current in the liquid-filled canals

that move the strands.

**Claim 61 (withdrawn):** A method of fabricating a nano-pore in-situ for a read station in a

storage device, comprising:

forming first and second chambers having a shared wall;

forming a hole in said shared wall; and

depositing nano-particles in the hole to shrink its size.

**Claim 62 (withdrawn - currently amended):** The method of claim [[63]]61, wherein the

nano-particles are deposited using an electroless-plating process.

**Claim 63 (original - currently amended):** The method of claim [[63]]61, further comprising

measuring an electric current through the shrinking hole and stopping deposition when the

current reaches a certain value.

**Claim 64 (previously presented):** The storage device of claim 12, wherein the molecular

material includes at least two distinct bases, said write head comprising:

at least two reservoirs containing the different bases and a blocking group;

a main chamber coupled to the reservoirs by respective nano-pores;

an anchor in the main chamber for holding one end of a seed strand;

electrodes for applying a voltage between the main chamber and a selected reservoir to cause a free-floating end of the seed strand to enter the selected reservoir through its nano-pore where a single base and blocking group are added to the free-floating end of the seed strand and then to return to the main chamber; and

a mechanism that removes the blocking group from the seed strand in the main chamber to prepare the strand for entry into the next reservoir.

**Claim 65 (previously presented):** The storage device of claim 12, wherein the molecular material includes at least two distinct bases, said write head comprising:

a tank partitioned into an upper chamber and a lower chamber connected by a nano-pore, said chambers being filled with a buffer solution and said upper chamber containing enzymes for joining base units to a strand;

a chamber having at least two reservoirs containing different bases in a buffer solution, each reservoir having a nano-pore at one end placed in the upper chamber of the tank;

a plurality of electrodes positioned in the upper and lower chambers and the at least two reservoirs to apply a series of electrical pulses that inject bases from their respective reservoirs into the upper chamber where they are sequentially joined to the strand to encode the sequence of binary data and, once encoded, that transfer the strand to the lower chamber.

**Claim 66 (currently amended):** The storage device of claim [[67]]65, further comprising:

a monitoring station that senses the injection of a base into the upper chamber and closes the nano-pores so that only one base is joined to the strand at a time and senses the strand as it passes from the upper chamber through the nano-pore to the lower chamber to ensure that the strand represents the sequence of binary data.

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17

**Claim 67 (previously presented):** The storage device of claim 12, wherein the blank strand comprises molecular bases having at least two states, the write head comprising:

an activator that transforms the bases into one of its states; and

a transport mechanism that pulls the strand past the activator to write the sequence of binary data into the strand.

**Claim 68 (currently amended):** The storage device of claim [[69]]67, wherein the blank strand comprises inert segments that separate the bases, the write head further comprising:

an exciser that removes the inert segments from the strand after the bases have been activated; and

a splicer that splices the active molecules back together into the strand.

**Claim 69 (previously presented):** The storage device of 13, wherein the write head comprises:

a first chamber having a strand of molecules and nano-particles;

a second chamber having an access window, a chamber wall separating said first and second chambers having an ion-channel formed therein with the trans side of the wall being chemically modified with surface attached photosensitizer groups capable of reducing the nano-particles;

a transport mechanism for pulling the strand and nano-particles through the ion-channel; and

a laser that emits pulses through the access window to excite the photosensitizers and activate reduction of the nano-particles to form nano- clusters bound to the strand at selected locations to encode the sequence of binary data.

**Claim 70 (currently amended):** The storage device of claim [[71]]69, wherein the nano-particles are Ag+ ions.

**Claim 71 (previously presented):** The storage device of claim 12, wherein the write head writes the binary data sequence into a strand using a ring-opening metathesis polymerization (ROMP) process.

**Claim 72 (currently amended):** The method of claim [[46]]44, wherein the strand of molecular bases is written by,

anchoring one end of a seed strand,

applying a voltage to cause a free-floating end of the seed strand to enter through a nano-pore to a selected reservoir where a single molecular base and blocking group are added to the free-floating end of the seed strand;

extracting the strand from the reservoir; and

removing the blocking group from the seed strand to prepare the strand for entry into the next reservoir.

**Claim 73 (currently amended):** The method of claim [[46]]44, wherein the strand is written by,

storing different bases in a buffer solution in at least two different reservoirs;

extracting a single base through nano-pores in the reservoirs into a first chamber filled with buffer solution and enzymes;

joining the base to grow a strand;

repeating the extraction and joinder until the strand is encoded with the binary sequence of data; and

transferring the strand to a second chamber where it can be moved to the memory address.

**Claim 74 (currently amended):** The method of claim [[75]]73, further comprising:

sensing the extraction of a base to close the nano-pores so that only one base is joined to the strand at a time; and

sensing the strand as it passes from the first chamber through a nano-pore to the second chamber to ensure that the strand represents the sequence of binary data.

**Claim 75 (currently amended):** The method of claim [[46]]44, wherein the strand is written by,

receiving a blank strand of bases, each base having at least two possible states; and

selectively transforming the state of each base as the strand is pulled past a write head to write the sequence of binary data into the strand.

**Claim 76 (currently amended):** The method of claim [[77]]75, wherein the bases are separated by inert segments in the blank strand, further comprising after all of the bases are transformed,

excising the inert segments from the strand; and

splicing the active molecules back together to reform the strand.

**Claim 77 (currently amended):** The method of claim [[47]]45, wherein the strand of molecules is written by,

chemically modifying the trans side of a chamber wall with surface attached photosensitizer groups capable of reducing a certain nano-particle;

pulling a strand of molecules and the certain nano-particles through an ion-channel formed in a chamber wall; and

emitting laser to excite the photosensitizers and activate reduction of the nano-particles

to form nano-clusters bound to the strand at selected locations to encode the sequence of binary

data.

**Claim 78 (currently amended):** The method of claim [[46]]44, wherein the strand of

molecules is written using a ring-opening metathesis polymerization (ROMP) process.

**Claim 79 (currently amended):** The method of claim [[47]]45, wherein the strand of

molecules is written by,

chemically modifying the trans side of a chamber wall with surface attached

photosensitizer groups capable of reducing a certain nano-particle;

pulling a strand of molecules and the certain nano-particles through an ion-channel

formed in a chamber wall; and

emitting laser to excite the photosensitizers and activate reduction of the nano-particles

to form nano-clusters bound to the strand at selected locations to encode the sequence of binary

data.

**Claim 80 (currently amended):** The method of claim [[46]]44, wherein the strand of

molecules is written using a ring-opening metathesis polymerization (ROMP) process.

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21